sensors in the generator, the inverter connected to the generator, a plurality of voltage sensors, the voltage regulator as disclosed in claim 1 and the generator shaft as disclosed in claim 5 must be shown or the features canceled from the claim(s).

Submitted herewith are proposed drawing corrections shown in red to change Figs. 1 and 2 and to add new Fig. 3 to illustrate these features clearly. Specifically, Fig. 1 has been amended to clarify the generator control in Fig. 1 by a dashed line and label. Fig. 2 has been slightly amended to add the estimated flux. Fig. 3 has been added to show the generator, the current sensors, and the inverter. Regarding the current sensors, the claims do not specifically recite "current sensors in the generator" as stated in the office action. Rather, claim 1, for example recites "measuring a plurality of current amounts in the generator using a plurality of current sensors". As discussed at the interview, the current sensors can measure the current amounts in the generator if they are located in the generator or inverter or in between these elements, as is well known. In any event, the current sensors have been shown schematically in Fig. 3.

The location of the voltage sensors is the same as the current sensors. However, the voltage sensors have been removed from claims 1 and 6. Claims 1 and 6 have been amended to recite

"measuring a plurality of generator voltages;" and "transforming the plurality of generator voltages into the two phase reference system". Therefore, applicants submit that it is unnecessary to show the voltage sensors in the figures.

Regarding the "voltage regulator", applicants respectfully submit that this element is currently shown in Fig. 1 in the box labeled "DC Voltage Regulator and T^* Regulator".

Regarding the drawing objection for claim 5, applicant also respectfully submits that claim 5 recites "obtaining a desired generator shaft torque amount" rather than a "generator shaft" as noted in the drawing objection. Since this is a quantity rather than a structural element, applicant submits that it is not necessary to amend the drawings to show this quantity.

It is respectfully requested that the Examiner approve the proposed drawing changes to Figs. 1-2 and new Fig. 3 when acting on this amendment.

In view of the changes to the drawings, it is submitted that the drawing objections have been overcome and should be withdrawn.

Claims 1-20 were rejected under 35 USC 112, second paragraph, as being indefinite. Regarding claim 1, the Examiner indicated that claim 1 discloses a d-axis voltage to reduce a

flux error and a q-axis voltage to reduce the torque error. The Examiner asked what about the relationship between the q-axis voltage and the torque of the generator.

As discussed at the interview, the q-axis voltage gives the q-axis current which in turn produces the torque. Also, the d-axis voltage gives the d-axis current which in turn generates the flux.

Regarding claim 5, the Examiner stated that claim 5 discloses obtaining a torque amount by a mapping function. The Examiner asked about the "mapping function". As also discussed at the interview, the mapping function can be a type of lookup table as shown in Fig. 1. The lookup table is usually based on the results of many empirical calculations. It is also possible to represent the mapping function by a graphical representation which would give further details.

In view of the above comments, it is respectfully submitted that the 35 USC 112, second paragraph rejection has been overcome and should be withdrawn. If the Examiner believes that additional claim amendments are needed to clarify these claims, the Examiner is requested to suggest appropriate language for applicants' consideration.

Claims 1-4, 11, 13-16 and 18-20 were rejected under 35 USC 103(a) as being obvious over Seibel et al. (U.S. Patent No. 6,014,007) in view of Heikkila (U.S. Patent No. 6,094,364). The Examiner admitted that Seibel et al. did not disclose using a torque error. The Examiner believed that Heikkila discloses a direct torque control using a torque controller T_c in Fig. 5, which is involved in the torque error in column 10, lines 40-44. The Examiner believed that it would have been obvious to one having ordinary skill in the art at the time the invention was made to design a controller as disclosed by Seibel et al. and to modify it by using a torque error for the purpose of reducing torque ripple and noise as disclosed by Heikkila.

Further, claims 5-10, 12 and 17 were rejected under 35 USC 103(a) as being obvious over Seibel et al. (U.S. Patent No. 6,014,007) and Heikkila as applied to claim 1, 11 and 16 above and further in view of Seibel et al. (U.S. Patent No. 5,717,305). The Examiner indicated that the combined control invention did not disclose a generator shaft torque.

The Examiner believed that it would have been obvious to one having ordinary skill in the art at the time the invention was made to design the combined control invention and to use a generator torque for the purpose of achieving proper torque

during the starting and maintaining stability for the system as disclosed by Seibel '305.

These rejections are respectfully traversed in view of the remarks given at the interview and those presented below.

The present invention deals with control of induction generators and is inspired by DTC concepts, previously applied only to motor control. The features that distinguish this invention from the prior systems include:

1. DTC is used to control induction generators;
2. Both generator torque and generator output voltage are controlled; and
3. No current regulators are used when defining the generator input voltages (V_d and V_q).

One application of the present invention is to an induction generator for automotive use and specifically to an induction machine automotive starter-alternator. Another application of the method of the invention is with a windmill.

As can be understood, the present invention relates to a voltage and a loading torque control of a generator. In, for example, a moving vehicle, the internal combustion engine (ICE) needs to supply a torque to both the wheels and the generator. In that situation, as in some other applications, it is important

to instantaneously arbitrate between the driver demand (wheel load torque) and the generator shaft torque, so that their sum does not exceed the available ICE torque. This is accomplished by controlling the amount of shaft torque, by which a generator loads an ICE. In the case of the vehicle, while the vehicle is moving, the switch S1 shown in Fig. 1, is in the "0" position and the commanded shaft torque is determined by the system controller, based on the vehicle operating conditions. When the vehicle is stopped, the switch is in position "1" and the generator is controlled in a voltage mode. In implementing these features, the control of the present application uses some of the existing components, for example, the induction machine, sensors, comparators, regulators, etc.

Seibel et al.'007 discloses a method for re-energizing a rotating motor, without bringing it first to a full stop. This situation happens with large inertia loads during power interruptions. It is called in the industry "catching the rotor on a fly". Seibel et al. '007 discloses a motor vector control and as such, requires current regulators, shown in Figure 3 and on page 1. In the present invention, there are no current regulators.

Seibel et al. '007 does not deal with generator control as disclosed and claimed in the present application.

Heikkila does not make up for the deficiencies in Seibel et al. '007. Heikkila discloses using a direct torque control (DTC) method for regulation of a flux and an electromagnetic torque in an induction motor. Furthermore, Heikkila discloses that the commanded quantities are the flux and the motor electromagnetic torque. In the present invention, the commanded quantities are flux and the inverter input DC voltage or the generator shaft torque. The Examiner cites the torque controller (Fig. 5) and the torque error (column 10, lines 40-44) as the main points of Heikkila. The torque controller is used for the purpose of reducing torque ripple and noise, in an induction motor. The objectives of the present invention have no relationship to torque ripple or noise. Further, the present invention deals with an entirely different set of commanded quantities and applies to a generator.

Seibel et al. '305 discloses a method for a sensorless vector (Field Oriented) control of an induction motor, during starting and normal operation. As such, among others points, it uses current regulators. Seibel et al. '305 also mentions, in the Abstract that "The generator operates on torque and flux

reference signals and on d-axis voltage reference & feedback signals to determine the electrical frequency". This sentence, then reference to a generator means an electronic circuit and not a rotating machine, as in the present disclosure. Furthermore, this is the only place where torque control is mentioned in Seibel et al. '305. All of the figures show a speed-controlled motor, with only implicit regulation of the torque, through inner loops, as a current reference. Finally, even the implicit mentioning of the torque regulation refers to an electromagnetic torque, while the present invention is primarily concerned with a generator shaft torque.

Seibel et al. '305 has no relationship to the present invention dealing with direct torque control without current regulators because it is dealing with vector control. Further, Seibel et al. '305 deals with a sensorless method for low speed/starting motor operation. The present invention is concerned with generator control, where a generator is started can be driven, for example, by an ICE.

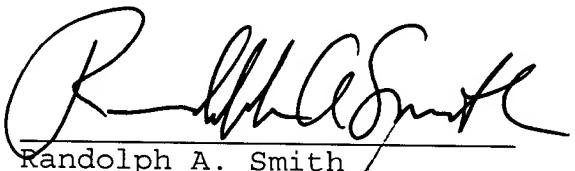
It is therefore submitted that Seibel et al. '007, Heikkila, and Seibel et al. '305, do not disclose or suggest the presently claimed invention. Specifically, none of these references, individually or in combination, disclose the elements of the

independent claims. Further, there is no teaching or suggestion in these references for combining them in a manner to render the present claims obvious.

Therefore, applicants respectfully submit that the application is now in condition for allowance and an action to this effect is respectfully requested.

If there are any questions or concerns regarding this application, the Examiner is requested to telephone the undersigned at the telephone number listed below.

Respectfully submitted,



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